WHAT IS CLAIMED AS NEW AND DESIRED TO BE SECURED BY LETTER PATENT OF THE UNITED STATES IS:

1. A camera apparatus comprising a zoom lens, said zoom lens comprising:

a first lens band having a positive focal length;

a second lens band having a negative focal length;

at least third to fifth lens bands having positive focal lengths; and

an aperture diaphragm located in the vicinity of the third lens band;

wherein, said second lens band smoothly moves toward the third lend band and said fourth lens band moves from the fifth lens band side toward a long focal point end so as to shear a magnifying function together with the second lens band, when magnification is performed from short to long focal point ends.

2. A mobile information terminal, comprising a camera apparatus having a zoom lens, said zoom lens comprising:

a first lens band having a positive focal length;

a second lens band having a negative focal length;

at least third to fifth lens bands having positive focal lengths; and

an aperture diaphragm located in the vicinity of the

third lens band;

wherein, said second lens band smoothly moves toward the third lend band and said fourth lens band moves from the fifth lens band side toward a long focal point end, when magnification is performed from short to long focal point ends.

3. A zoom lens, comprising:

a first lens band having a positive focal length;

a second lens band having a negative focal length;

at least third to fifth lens bands having positive focal lengths; and

an aperture diaphragm located in the vicinity of the third lens band;

wherein, said second lens band smoothly moves toward the third lend band and said fourth lens band moves from the fifth lens band side toward a long focal point end, when magnification is performed from short to long focal point ends.

4. The camera apparatus according to claim 1, wherein a distance ($D_{1w}$) between the first and second lens bands in the short focal point end arrangement, a distance ($D_{1t}$) between the first and second lens bands in the long focal point end arrangement, a distance ($D_{3w}$) between the third and fourth lens bands in the short focal point end arrangement, and a distance

($D_{3T}$) between the third and fourth lens bands in the long focal point end arrangement substantially meet the following inequality:

$$(D_{3W} - D_{3T}) / (D_{1T} - D_{1W}) > 0.3$$

5. The camera apparatus according to any one of claims 1 and 3, wherein the first lens band faces an object to be photographed.

6. The camera apparatus according to any one of claims 1 and 3, wherein said fourth lens band comes closest to the third lens band at a focal length slightly before the long focal point end.

7. The camera apparatus according to any one of claims 1 and 3, wherein a variance of an image surface caused by these smooth movements of said second and fourth lens bands is compensated by movement of the fifth lens band in a predetermined direction.

8. The camera apparatus according to claim 7, wherein said first lens band is immobile.

9. The camera apparatus according to claim 7, wherein

said third lens band and aperture diaphragm are immobile.

10. The camera apparatus according to claim 7, wherein the fifth lens band performs focussing.

11. The camera apparatus according to claim 7, wherein a focal length ($f_1$) of the first lens band, and a composite focal length ($f_{12T}$) of the first and second lens bands at the long focal point end substantially meet the following inequality:

$$-1.4 < (f_{12T} / f_1) < -1.0$$

12. The camera apparatus according to claim 7, wherein a composite focal length ($f_{12W}$) of the first and second lens bands at the short focal point end, a composite focal length ($f_{12T}$) of the first and second lens bands at the long focal point end, a focal length ($f_T$) of the entire lens unit at the long focal point end, and a focal length ($f_W$) of the entire lens unit at the short focal point end substantially meet the following inequality:

$$0.4 < (f_{12T} / f_{12W}) / (f_T / f_W) < 0.7$$

13. The camera apparatus according to claim 7, wherein each of said lens bands includes less than three lenses, said second and third lens bands include at least one non-spherical

surface, and at least one of said fourth and fifth lens band includes more than one non-spherical surfaces.

14. The camera apparatus according to claim 7, wherein said first to third and fifth lens bands include less than three lenses, said fourth lend band includes four lenses, each of said second and third lens bands includes at least one non-spherical surface, and at least one of said fourth and fifth lens band includes more than one non-spherical surfaces.

15. The camera apparatus according to claim 7, wherein said fifth lens band includes only one lens.

16. The camera apparatus according to claim 7, wherein said aperture diaphragm is located at the object side of the third lens band.

17. The camera apparatus according to claim 7, further comprising a function of digitizing a photographed image into digital information.

18. The camera apparatus according to claim 17, further comprising a photo acceptance unit configured to receive an image from the zoom lens, said photo acceptance unit having

almost three millions of pixels.

19. The camera apparatus claimed in any one of claims 1, and 4 to 15, said zoom lens further comprising a macro mode capable of focussing at a shorter distance than an ordinal photographing region, wherein said focussing is performed by movement of the fifth lens band in a predetermined direction in any one of the ordinal photographing region and the macro mode.

20. The camera apparatus according to claim 19, wherein said fourth lens band in the macro mode is substantially close to the fourth lens band in the long focal point end arrangement.

21. The camera apparatus according to claim 19, wherein said second lens band in the macro mode is substantially closer to the image surface than when it is in the short focal point end arrangement.

22. The camera apparatus according to claim 19, wherein said fourth lens band in the macro mode is close to the fourth lens band in the long focal point end arrangement, and wherein said second lens band in the macro mode is closer to the imaging surface than when it is in the short focal point end arrangement.

23. The camera apparatus according to claim 19, wherein the first and third lens bands and the aperture diaphragm are immobile with regard to the image surface.

24. The camera according to claim 19, wherein a distance ($L_{1W}$) between the first and second lens bands in the short focal point end arrangement, a distance ($L_{1T}$) between the first and second lens bands in the long focal point end arrangement, a distance ($L_{1C}$) between the first and second lens bands in the macro mode substantially meet the following inequality:

$$0.15 < (L_{1C} - L_{1W}) / (L_{1T} - L_{1W}) < 0.40$$

25. The camera apparatus according to claim 19, wherein a distance ($L_{3W}$) between the third and fourth lens bands in the short focal point end arrangement, a distance ($L_{3T}$) between the third and fourth lens bands in the long focal point end arrangement, a distance ($L_{3C}$) between the third and fourth lens bands in the macro mode substantially meet the following inequality:

$$0.25 < (L_{3C} - L_{3W}) / (L_{3W} - L_{3T}) < 0.50$$

26. The zoom lens according to claim 19, wherein a distance ($L_{1W}$) between the first and second lens bands in the

short focal point end arrangement, a distance ($L_{1T}$) between the first and second lens bands in the long focal point end arrangement, a distance ($L_{1C}$) between the first and second lens bands in the macro mode substantially meet the following inequality:

$$0.15 < (L_{1C} - L_{1W}) / (L_{1T} - L_{1W}) < 0.40$$

and wherein a distance ($L_{3W}$) between the third and fourth lens bands in the short focal point end arrangement, a distance ($L_{3T}$) between the third and fourth lens bands in the long focal point end, a distance ($L_{3C}$) between the third and fourth lens bands in the macro mode substantially meet the following inequality:

$$0.25 < (L_{3C} - L_{3W}) / (L_{3W} - L_{3T}) < 0.50$$

27. The camera apparatus according to claim 19, wherein said first to third and fifth lens bands include less than three lenses, said fourth lend band includes four lenses, each of said second, third and fifth lens bands includes at least one non-spherical surfaces, and the fourth lens band includes more than two non-spherical surfaces.

28. The camera apparatus according to claim 19, wherein said third lens band includes one lens, and said aperture diaphragm is located at the object side of the third lens band.

29. A method for zooming, comprising the steps of:

providing a first lens band having a positive focal length;

providing a second lens band having a negative focal length;

providing at least third to fifth lens bands having positive focal lengths; and

providing an aperture diaphragm located in the vicinity of the third lens band;

smoothly moving said second lens band toward the third lend band;

substantially simultaneously moving said fourth lens band from the fifth lens band side toward a long focal point end so as to shear a magnifying function together with the second lens band when magnification is performed from short to long focal point ends.

30. The method according to claim 29, further comprising the step of bringing said fourth lens band closest to the third lens band at a focal length slightly before the long focal point end in the step of substantially simultaneously moving said fourth lens band.

31. The method according to claim 29, further comprising

the step of compensating a variance of an image surface caused by these smooth movements of said second and fourth lens bands with movement of the fifth lens band in a predetermined direction.

32. The method according to claim 29, further comprising the step of fixing said first lens band when said magnification is performed.

33. The method according to claim 29, further comprising the step of fixing said third lens band and aperture diaphragm when said magnification is performed.

33. The method according to claim 29, further comprising the step of performing focussing with the fifth lens band when said magnification is performed.

34. The method according to claim 29, further comprising the step of digitizing a photographed image into digital information.

35. The method according to claim 29, further comprising

the step of focussing at a shorter distance than an ordinal photographing region by moving the fifth lens band in a predetermined direction in any one of the ordinal photographing region and the macro mode.

36. The method according to claim 29, further comprising the step of positioning said fourth lens band substantially close to the fourth lens band in the long focal point end arrangement for the macro mode.

37. The method according to claim 29, further comprising the step of positioning said second lens band substantially closer to the image surface than when it is in the short focal point end arrangement for the macro mode.

38. The method according to claim 29, further comprising the step of fixing the first and third lens bands and the aperture diaphragm with regard to the image surface.

39. A camera apparatus comprising zoom means for performing zooming, said zoom means comprising:

first means for deflecting a light, said first means having a positive focal length;

second means for deflecting the light, said second means

having a negative focal length;

at least third to fifth means for deflecting the lights, said at least third to fifth means having positive focal lengths; and

means for narrowing the light in the vicinity of the third means;

wherein, said second means smoothly move toward the third means and said fourth means move from the fifth means side toward a long focal point end so as to shear a magnifying function together with the second means when magnification is performed from short to long focal point ends.

40. The camera apparatus according to claim 39, wherein said fifth means perform focussing during zooming.

41. A computer program product which stores computer program instructions which when executed by a computer results in a zooming operation in a camera apparatus including a first lens band having a positive focal length, a second lens band having a negative focal length, at least third to fifth lens bands having positive focal lengths, and an aperture diaphragm located in the vicinity of the third lens band, comprising the steps of:

smoothly moving said second lens band toward the third

lend band; and

substantially simultaneously moving said fourth lens band from the fifth lens band side toward a long focal point end so as to shear a magnifying function together with the second lens band when magnification is performed from short to long focal point ends.



ABSTRACT

A zoom lens includes a first lens band having a positive focal length, a second lens band having a negative focal length, and at least third to fifth lens bands having positive focal lengths. An aperture diaphragm is located in the vicinity of the third lens band. When magnification i.e., zooming is performed from short to long focal point ends, the second lens band smoothly moves toward the third lend band and the fourth

lens band simultaneously moves from the fifth lens band side toward a long focal point end so as to shear a magnification function together with the second lens band.